FINAL REPORT
Limited Biota Survey for Devils Lake, ND

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Survey Conducted July 25-30, 2005

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DISCLAIMER

This report presents additional technical information gathered through a limited survey of aquatic biota conducted in Devils Lake, North Dakota. Participation by the Council on Environmental Quality, Minnesota Department of Natural Resources, North Dakota Game and Fish Department, North Dakota Department of Health, North Dakota State Water Commission, Manitoba Water Stewardship, Environment Canada, Fisheries and Oceans Canada, U.S. Army Corps of Engineers, U.S. Department of State, and U.S. Fish and Wildlife Service in gathering data and/or reviewing and providing input into this report does not represent any jurisdiction's position as it relates to the State of North Dakota's Devils Lake outlet.

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The following personnel were involved in the coordination of the limited biota survey and preparation of this report:

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Executive Summary

This limited biota survey was undertaken to address recognized data gaps about aquatic biota of concern in Devils Lake, North Dakota. Within the context of this effort, biota of concern includes a group of agreed upon species that all the interested jurisdictions recognized as ecologically undesirable because of their potential impacts. This effort stems from a collaborative process that involved interested jurisdictions that could be affected by the operation of the State of North Dakota's Devils Lake outlet. These jurisdictions include the State of North Dakota, State of Minnesota, the Province of Manitoba, and the federal governments of Canada and the United States. The purpose of this limited biota survey is to provide additional information regarding the potential for the presence of aquatic biota of known concern in Devils Lake. To assure scientific integrity, the results must be viewed and evaluated in relation to the following caveats:

- The participants recognize that no sampling method is guaranteed to provide evidence of every single species present in a prescribed area. However, additional information is always useful, and the current survey provides an updated picture of Devils Lake's biota relative to previous studies.
- Data collection efforts were focused primarily on detecting the presence or absence of an agreed upon list of biota of concern that all jurisdictions recognized to be of most concern and do not represent a comprehensive survey of biota in Devils Lake.
- This effort does not alleviate existing data gaps in the knowledge of the Sheyenne River, Red River and its tributaries and/or Lake Winnipeg, nor does it represents a risk assessment.
- Due to the inherent limitations of the present survey, these results should inform, but not be the sole determinant of, the process to establish the type of permanent mitigation that may be required to prevent the potential transfer of biota of concern from Devils Lake to the Sheyenne River through the operation of an outlet.
- The present fish parasite and pathogens survey was based on samples at one point in time. The occurrence and prevalence of certain fish pathogens may be variably affected by life history characteristics and environmental factors, especially those that cause or increase stress in fish.

The list of species of known concern included:

Aquatic macrophytes of concern - flowering rush (*Butomus umbellatus*), Eurasian water milfoil (*Myriophyllum spicatum*), curly leaf pondweed (*Potamogeton crispus*), and brittle naiad (*Najas minor*).

Aquatic invertebrates of concern - rusty crayfish (*Orconectes rusticus*), zebra mussels (*Dreissena polymorpha*), Chinese mystery snail (*Cipangopaludina spp*.), spiny water flea (*Bythotrephes cederstroemi*), an exotic daphniid (*Daphnia lumholtzi*), quagga mussel (*Dreissena bugensis*), New Zealand mud snail (*Potamopyrgus antipodarum*), and an "exotic" amphipod (*Echinogammarus ischnus*).

Fish of concern – striped bass (*Morone saxatilis*).

Additionally, the U.S. Fish and Wildlife Service surveyed fish from Devils Lake for pathogens and parasites following the National Wild Fish Health Survey protocols.

Sampling was conducted July 26 to July 30, 2005 utilizing agreed-upon methods for sampling aquatic biota of concern and for selecting sites to sample throughout the lake. This survey was based upon a rapid and cursory evaluation approach developed by the participating jurisdictions.

None of the target aquatic invertebrates or macrophytes of concern were recorded or collected during this survey. However, due to seasonal community composition shifts some species of concern may not have been detected either because we sampled during the summer, because they occur in low abundance or are not present in Devils Lake.

Over 300 fish from various species were examined and tested from Devils Lake using the protocols of the National Wild Fish Health Survey. Antigen of *Renibacterium salmoninarum*, causative agent of bacterial kidney disease, was detected in all fish species by the enzyme-linked immunosorbent assay (ELISA). Consistent with established protocols of the National Wild Fish Health Survey confirmation tests were conducted on a total of 21 fish representing 7 different fish species, but confirmation tests failed to confirm the presence of this agent. *Ligula intestinalis* and *Gyrodactylus hoffmani* were initially identified as a species of concern. Only *L. intestinalis* was found during this survey. Striped bass are listed as a fish of concern, no specific sampling occurred during this survey. However, over 11,000 hours of sampling (2000-2004), with 50,000 fish netted, and over a million angler hours a year, have failed to yield a single record of a striped bass since 1993.

We also report on other aquatic biota found during the course of this effort. For the most part we cannot provide definitive assessments of their potential impacts to Devils Lake, the receiving waters and ultimately to the Nelson River drainage. The results of this effort must be considered in light of the applicable caveats listed above. Additionally, the limitations of the effort as it relates to detecting seasonal variations, if any, of Devils Lake biota must be recognized when evaluating the results since we only sampled during the summer period. These results should inform any management decisions made regarding the operation of the outlet, but not be the sole determinant of such decisions. All of the information gathered in this report will be taken into consideration in discussions about long-term monitoring efforts.

Introduction

It is recognized that our understanding of biological community structure in Devils Lake, the Red River watershed and Nelson River drainage is incomplete. However, this survey represents the most recent and focused effort to determine the presence or absence of biota of concern in Devils Lake and most likely within the Nelson River watershed. Where possible and appropriate, the results of this study have been placed in the context of available information from the wider Nelson River Basin. The results of this effort cannot be used to identify species that may be unique to Devils Lake, nor can they be used to assess the impact (if any) associated with transfer of any such species to the Red River watershed and/or the Nelson River drainage. A long-term, multi-year and multi-season monitoring program is necessary for such an analysis.

This limited biota survey was undertaken to address recognized data gaps about aquatic biota of concern in Devils Lake, North Dakota. Within the context of this effort, biota of concern includes a group of agreed upon species that all the interested jurisdictions recognized as ecologically undesirable because of their potential impacts. This effort stems from a collaborative process that involved interested jurisdictions that could be affected by the operation of the State of North Dakota's Devils Lake outlet. These jurisdictions are the State of North Dakota, State of Minnesota, the Province of Manitoba, and the federal governments of Canada and the United States. These jurisdictions are currently engaged in negotiations that will benefit from additional information on the Devils Lake aquatic biota. Concerns are centered around the potential downstream dispersion of biota of concern via the State of North Dakota Devils Lake outlet.

The purpose of this effort is to provide additional information regarding the potential for the presence of aquatic biota of concern in Devils Lake. This report relies on results and analysis undertaken by Manitoba Water Stewardship (Williamson et. al., 2005), Minnesota Department of Natural Resources (Montz, 2005 and Perleberg, 2005), North Dakota Game and Fish Department information, U.S. Fish and Wildlife Service (Hudson and Peters, 2005), and on data and analysis by the survey participants (see List of Survey Participants). In order to assure scientific integrity, the results must be considered in relation to the following caveats:

- The participants recognize that no sampling method is guaranteed to provide evidence of every single species present in a prescribed area. However, additional information is always useful, and the current survey provides an updated picture of Devils Lake's biota relative to previous studies.
- Data collection efforts were focused primarily on detecting the presence or absence of a selected number of species that all jurisdictions agreed to be of most concern and do not represent a comprehensive survey of biota in Devils Lake.
- This effort does not alleviate existing data gaps in the knowledge of the Sheyenne River, Red River and its tributaries and/or Lake Winnipeg nor does it represents a risk assessment.
- Due to the inherent limitations of the present survey, these results should inform, but not be the sole determinant of, the process to establish the type of permanent mitigation that may be required to prevent the potential transfer of biota of concern from Devils Lake to the Sheyenne River through the operation of an outlet.

- The fish parasite and pathogens survey conducted in support of this effort was based on samples at one point in time. The occurrence and prevalence of certain fish pathogens may be variably affected by life history characteristics and environmental factors, especially those that cause or increase stress in fish.

With these caveats in mind, it is clear that this survey is not a substitute for any appropriate mitigation efforts or technologies under consideration by the jurisdictions involved in negotiations. This effort is to increase our knowledge base regarding Devils Lake and hopefully serve as a model for future cooperation and the development of our collective understanding of not only Devils Lake, but also of the Sheyenne River and Red River and Lake Winnipeg.

The list of species of known concern included:

Aquatic macrophytes of concern - flowering rush (*Butomus umbellatus*), Eurasian water milfoil (*Myriophylum spicatum*), curly leaf pondweed (*Potamogeton crispus*), and brittle naiad (*Najas minor*).

Aquatic invertebrates of concern - rusty crayfish (*Orconectes rusticus*), zebra mussels (*Dreissena polymorpha*), Chinese mystery snail (*Cipangopaludina spp*.), spiny water flea (*Bythotrephes cederstroemi*), an exotic daphniid (*Daphnia lumholtzi*), quagga mussel (*Dreissena bugensis*), New Zealand mud snail (*Potamopyrgus antipodarum*), and an "exotic" amphipod (*Echinogammarus ischnus*).

During this survey no effort was focused on one species, striped bass (*Morone saxatilis*). All jurisdictions agreed that additional sampling for this fish species of concern would not be part of this limited survey due to the extensive annual netting efforts already undertaken by the North Dakota Game and Fish Department. The U.S. Fish and Wildlife Service performed fish examinations to assess the presence of any fish parasites (both ecto and endoparasites), bacterial and viral pathogens as described in the National Wild Fish Health Survey.

Sampling was conducted from July 26 to July 30, 2005. The methods utilized (see methods section below) were developed in close coordination among all of the jurisdictions through a consensus process facilitated by Council on Environmental Quality staff. On-site adjustments of the sampling methods were made, as needed, to ensure adequate coverage of the targeted areas and to reflect on-the-water realities that the teams faced given the limitations of available time and resources. Sampling was conducted by staff from Council on Environmental Quality (CEQ), Minnesota Department of Natural Resources (MNDNR), North Dakota Game and Fish Department (NDGFD), North Dakota Department of Health (NDHD), Manitoba Water Stewardship (MWS), U.S. Army Corps of Engineers (USACOE), and U.S. Fish and Wildlife Service (USFWS).

During the course of the survey other aquatic biota were encountered. While the focus of the survey was on identifying whether or not agreed upon, species of concern were present in the lake and to conduct additional work on fish pathogens and parasites, the sampling effort provided additional information on the lake's phytoplankton, zooplankton, aquatic macrophytes and benthic invertebrates.

Study Area

Devils Lake is located in Ramsey and Benson Counties, North Dakota (Figure 1). Water levels in this system have fluctuated since the end of glaciation (USGS 2000). In 2003, the lake was reported to have a surface area of 95,624 acres and a maximum depth of at least 50 feet (NDGFD 2003). A more recent report estimated the surface acreage at 139,400 acres (Wetzel, 2005).

Devils Lake includes several basins that vary in water depth, alkalinity, clarity, wind exposure, shoal substrate and history of water level fluctuations. Dissolved solids concentrations generally increase from west to east as water enters the western part of the lake and becomes progressively more concentrated by evaporation as it moves eastward (USGS 2000). These differences in physical, chemical and hydrologic properties likely influence the aquatic communities within each basin. Manitoba Water Stewardship and MNDNR conducted additional sampling in Stump Lake, which is located in Nelson County.

Methods

General

This limited biota survey was based upon a rapid and cursory evaluation approach that was agreed upon and utilized due to the extensive survey area and the limited time available. Surveyors would boat or wade through pre-selected sampling sites to collect and/or record aquatic macrophytes and an agreed upon small number of pre-selected aquatic invertebrate taxa. This method seemed especially appropriate for marinas (a likely location where species of concern might initially colonize) where establishing specific sampling points would be difficult. Additionally, it allowed for a greater number of areas to be surveyed. It was also agreed to develop a stratified sampling scheme, based upon major habitat types in and around the lake, with a special focus on the outlet intake, and areas that represent the diversity of major habitat types within Devils Lake. This helped focus the use of available resources and accommodate the compressed timeframe under which the survey effort was undertaken.

Consensus was reached to focus first on the in-lake populations and that sampling was stratified across the "separate" bays/basins of Devils Lake. Areas of importance for survey work included:

- Water depths less than two meters. Plant species diversity is typically greater in these shallower depths.
- Protected shoreline, bays or backwaters. Waters that are sheltered from wave action are more likely to support aquatic vegetation.
- Inlets and outlets.
- Artificial harbors and marinas.
- Public access locations.

Except for fish, sampling effort and locations were determined by a three-step process that included:

1) Identification of key habitat types in the lake;
2) Determination of the type(s) of sampling that should occur within each strata (method(s) selected should capture a broad range of taxa and are highly effective for targeted species of concern);
3) Insure that all major habitat types have at least a limited survey. The basis for such an agreement resides in the participant's agreement that a limited amount of effort in all the major habitat types is more valuable than a significant amount of effort in a few habitat types within the context of this limited biota survey.

The survey commenced on July 26, beginning on West Bay near the intake for the outlet and radiated outwards from this area to sample all the bays of the lake. Based on these agreements, staff from the NDGFD divided the lake into sections based on their familiarity with the lake, with the intention to sample all major habitat types represented in the lake (Figure 2). Each section was assigned an identification code for record keeping purposes and coordination of team locations. Teams were assigned to specific areas to sample for particular taxonomic groups, based upon expertise and available equipment. Sampling sites were located at one-mile intervals. Because of the unexpected simplicity of the aquatic macrophyte community encountered, as teams moved eastward the distance between sampling sites was increased to two-mile intervals in Main Bay and three-mile intervals at both East Bay and East Devils Lake. This was done to more effectively sample larger areas of the lake. Additionally, upon observing macrophyte growth, teams were requested to sample those locations regardless of distance from the previous sampling site. This provided further opportunities to sample the aquatic vegetation of the lake. At each site sampled, a data sheet showing date, time, GPS location, surveyor, identification code as described previously, and sampling method used was completed.

Participants from MWS and MNDNR also collected samples from Stump Lake on July 29th. Teams completed the survey of pre-selected sites on Devils Lake by July 29 with the exception of the survey for zebra mussels, which took place using volunteer divers from North Dakota on July 30. Invertebrate samples collected by MNDNR and MWS staffs were preserved for future identification off-site.

In total, sampling stations were visited and samples were collected at XXXX locations (see Figure 3). Approximately one sample was collected per ?? acres of surface area (or per ?? miles of shoreline).

Fish of Concern

Based on the existing and extensive Devils Lake fish surveys already conducted by NDGFD, additional fish surveys were not conducted as part of this survey effort. It was recognized that the survey techniques routinely used by NDGFD staff may not adequately sample certain benthic, less mobile species. Given the impracticality of sampling for benthic fish species in the time available to conduct this survey, it was agreed that no specific sampling would be attempted. However, any benthic fishes incidentally captured while surveying for macro-invertebrates were to be recorded.

Fish Pathogens and Fish Parasites of concern

Because of the expertise of the USFWS and the limited time available, it was decided that collection and analysis of fish pathogens and parasites would be done by the USFWS. It must be noted that the sampling techniques available within the time constraints for this effort did not allow for sampling of the benthic fish community. A separate report by the USFWS (including description of methods) is available at: www.NNNNNNN.

Aquatic Invertebrates of concern

Two teams collected and preserved aquatic macroinvertebrate samples from Devils Lake. Benthic invertebrate samples from the lake bottom were collected with a 23 cm by 23 cm by 32 cm Ekman dredge (Williamson et al. 2005). Dredge samples were washed through a Nitex nylon bag with a 500 µm mesh. Samples were immediately preserved with 70 % alcohol. The MNDNR crew collected aquatic invertebrate samples at a subset of locations which were sampled for aquatic macrophytes (Montz, 2005 and Perleberg, 2005). Not all sites sampled for vegetation were sampled for invertebrates. Samples were collected with a D-frame sweep net, either through wading along shorelines or by sweeping the net multiple times through aquatic macrophyte beds at different depths. Sampling also included margins of cattail beds, woody debris, rocks, sand and gravel shoals. Samples were qualitative with the primary focus being the snail fauna.

Survey areas of special focus included, but were not limited to:

1. Aquatic macrophytes: Submerged aquatic plant growth, particularly larger beds, are key habitat for macroinvertebrates. High species diversity can occur in these areas (e.g. snails, amphipods). These areas were sampled using sweep or kick nets.

2. Rock/cobble (consolidated) and/or larger stands of woody debris: Both of these habitats can support a different array of macroinvertebrate species than aquatic macrophytes beds. In particular, the consolidated substrate is ideal for crayfish. These areas were sampled by kick/sweep net and by conducting some qualitative hand picking.

3. Hard substrate at selected public boat access sites: Surveys for zebra mussel were conducted on July 30 by NDGFD personnel and divers from the Devils Lake search and rescue team. Six public boat ramps were visited and at each a diver dove to ten to fifteen feet to collect hard substrate samples. In our search for zebra mussels, hard substrates were collected by divers at depths of 10-15 feet to ensure that these substrates have been under water at least for the past three years and away from direct sunlight. Five-gallon buckets were used by the divers to collect the samples with approximate volume of samples of 3-4 gallons of hard substrates. The collected samples were transferred to plastic coolers for transport by NDGFD personnel to the Department's facilities for inspection and storage. Substrates were examined visually

and with the aid of 10X hand-held magnifying glass for both adult and juvenile zebra mussels. The water in the transfer coolers was also examined for zebra mussels that may have been dislodged during transport. In addition, samples from plankton tows were examined with cross-polarized light to look for zebra mussel veligers by MNDNR personnel.

Plankton of concern:

Two teams collected plankton samples at Devils Lake. Samples were collected from all bays of Devils Lake and from Stump Lake. This was accomplished by vertical and horizontal tows of a plankton net with locations (GPS coordinates) and sample identification recorded on a data sheet. Sampling type and locations are shown in Figure 3. Samples were collected from Devils and Stump lakes during the period July 27, 2005 to July 29, 2005. Samples were collected in duplicate in all cases and triplicate at some sites.

Boats were anchored during sample collection. Vertical tows were taken near the deepest location from each of the basins selected for sampling. Sampling was supplemented with horizontal near-surface tows in the near shore area. All species collected were identified and recorded.

Phytoplankton samples were collected with the use of a Wisconsin-style net with a mouth opening of 10 cm and a total length of 52 cm. The mesh size of the net was approximately 45 to 50 µm. Samples were fixed in the field with Lugol's solution and 70 % alcohol was added later for full preservation. One quarter to ½ mL aliquots were taken from each sample bottle and analyzed in a 2 mL utermohl chamber using an M40 Wild Inverted Microscope at magnifications of 234X, 468X, and 938X. The phytoplankton present were assessed qualitatively primarily for dominant taxa. The following taxonomic works were used for identifying the dominant cyanobacteria: Komarek and Anagnostidis (1999), Komarek and Komarkova (2002), Azevedo and Sant'Anna (2003), and Sant'Anna et al. (2004).

Zooplankton samples were collected with a Wisconsin-style net with a mouth opening of 25 cm and length of 100 cm. The first three sites (3C01, 3C02, and 3C03) were sampled with a net of 72 µm mesh and the rest of the sites were sampled with a net of 65 µm. Use of the slightly finer second net, necessitated by damage to the first, did not bias zooplankton species composition. Samples were immediately preserved with 70 % alcohol. Two - 1 mL aliquots were taken from each sample and examined under a compound microscope at several magnifications (25X to 160X). The crustacean plankton present were qualitatively but not quantitatively assessed. Identifications followed Brooks (1957), Wilson (1959), and Yeatman (1959).

Aquatic Macrophytes of concern

Devils Lake has an extensive littoral area and it was assumed that vegetation was sparse throughout that zone (Perleberg 2005). Therefore, rather than systematically sampling the entire littoral zone, specific areas of the lake were targeted for vegetation surveys. Within each of the basins, surveyors focused on lake areas where submerged or floating-leaved macrophytes were most likely to occur. The MNDNR crew used 2003 Farm Service aerial photos and a contour

map were quickly reviewed to select areas of potential macrophyte growth. In the field, surveyors navigated to a general area of the basin and then selected sample areas based on water depth, site protection and accessibility. Sampling focused on water depths less than nine feet. Wave-swept shorelines with extensive rip-rap were avoided because site conditions appeared unfavorable for macrophyte growth. Areas with visible surface growth of macrophytes and protected backwater areas were priority for sampling.

This sampling effort is qualitative and most effective at detecting commonly occurring species (Perleberg 2005). This approach should be effective in detecting any of the species of concern if they have well established populations in suitable habitats, but as stated in the caveats no method can be guaranteed to detect every species present at any location. However, the purpose of this survey was to focus on agreed upon species of known concern and augment our knowledge of the biota occurring at Devils Lake and not a comprehensive assessment of the Devils Lake biota.

At each selected sample area, surveyors recorded a GPS location, water depth and macrophyte species present. Visual surveys were made where feasible, particularly in areas where vegetation reached the water surface. A double-headed, weighted rake was used to sample submerged vegetation. Voucher specimens were collected for each macrophyte species found.

Terrestrial Plants of concern

Surveyors were to make observations along the shoreline specifically for flowering rush because this plant can grow in both terrestrial and aquatic habitats. If any suspect plants were observed voucher specimens and data sheets were to be completed and submitted.

Results

Fish of concern

Sampling locations established by NDGFD utilized from 2000 to 2005 are presented in Figure 4. The striped bass was introduced into Devils Lake in 1977 and has been frequently identified as a species of concern. The last striped bass recorded from Devils Lake, an adult, was caught by an angler in 1993. Between 2000 and 2004, NDGFD has netted over 50,000 fish without a single striped bass having been recorded. Despite extensive survey efforts (over 11,000 netting hours), and over a million angler hours of recreational fishing occurs annually there has not been any report of striped bass being caught since 1993.

Fish Pathogens and Fish Parasites of concern

Over 300 fish from various species were examined and tested from Devils Lake using the protocols of the National Wild Fish Health Survey. Overall, the health and condition of fish from Devils Lake appeared very good. None of the fish examined had any external or internal clinical signs that would indicate infection of a fish pathogen. Antigen of *Renibacterium*

salmoninarum, causative agent of bacterial kidney disease, was detected in all fish species by the enzyme-linked immunosorbent assay (ELISA). Consistent with established protocols of the National Wild Fish Health Survey confirmation tests were conducted on a total of 21 fish representing 7 different fish species, but confirmation tests failed to confirm the presence of this agent. *Ligula intestinalis* and *Gyrodactylus hoffmani* were initially identified as a species of concern. Only *L. intestinalis* was found during this survey, however this parasite is no longer considered a species of concern since it has already been recorded within the Nelson River drainage. The external parasite *Gyrodactylus hoffmani* was found during a previous survey at Devils Lake (see Peterson, 2002). This parasite was not detected during the present survey. It is not certain whether this parasite is still present in Devils Lake. To date, *Gyrodactylus hoffmani* has not been reported elsewhere in the basin despite some survey efforts in Manitoba. While this species has not been reported from Manitoba, the FWS survey (Hudson and Peters, 2005) states this species is ubiquitous in freshwater systems and has been reported from a variety of fishes in North America.

While an adequate sample size was obtained for some species, in many cases too few fish of other species were caught and examined to establish the presence or absence of fish pathogens with an appropriate level of confidence within the limited timeframe of this effort. It must also be recognized that fish pathogens and prevalence of fish pathogens may be variably affected by several life history stages and environmental characteristics and elements. However, this effort relied on almost double the sample size as the previous fish health survey conducted in Devils Lake (Peters, 2002) with similar results. For in-depth results of the USFWS fish pathogens and parasites analyses please see the USFWS report hosted on the following website: WWW.NNNN

Aquatic Invertebrates of concern

None of the target aquatic invertebrates of concern were recorded or collected during the limited biota survey. The crustacean zooplankton community data is listed in Table 1 and Table 1A (see Appendix 1). The network of sampling stations on Devils Lake and Stump Lake was determined to be adequate to characterize the mid-summer zooplankton community composition.

The snails collected were determined to be native species with no exotic snails recorded. Much of the invertebrate diversity was collected from northern milfoil beds in depths ranging from 4 – 6 feet or deeper. Sampling in shallower water was less productive (Montz 2005). Additional areas of diversity were in the cattail fringes. Many areas are dominated by amphipods. All specimens examined were *Gammarus lacustris*, a native amphipod whose range encompasses most of the northern part of the continent, (including North Dakota) and is often abundant in hard waters.

No crayfish were collected or observed, and NDGFD biologists suggested that they do not think there are any, as they have seen no evidence of any living crayfish or remnants thereof. However, sampling was not focused on crayfish.

No unique taxa were found in the benthic invertebrate community from Devils and Stump Lakes that have not been previously found downstream. No specimens of Chinese mystery snails

(*Cipangopaludina spp*.) or New Zealand mud snails (*Potamopyrgus antipodarum*) were collected. Benthic invertebrates collected and identified by the MWS's crew grab samples in soft sediment are listed in Table 2 (see Appendix 1).

Substrates examined for the presence of zebra mussels included rocks of 3 to 8 inches in diameter, beverage containers, boat trailer bunk rollers, bow guide, fishing lure, golf ball, and several other items. None of the substrates examined had any unusually thick layer of algae or sediment that would impede zebra mussels from attaching or hindering their growth. No zebra mussels were recorded or observed attached to these substrates. Examination of the coolers and water used in transporting the substrates to the NDGFD facilities contained no dislodged zebra mussels. No other mussel species was found on the substrates, transport coolers, or water examined. Additionally, no zebra mussel veligers were recorded in any of the zooplankton samples that were examined.

Aquatic Macrophytes of concern

None of the aquatic macrophytes of concern were found in Devils Lake. Aquatic macrophytes of Devils Lake were most often found in areas protected from heavy wave action and in depths less than ten feet of water where sufficient sunlight reaches the lake bottom. The current macrophyte community of Devils Lake includes at least eight submerged and three free-floating species and is characterized by species that tolerate high alkalinity and turbidity. Given the limited timeframe under which this survey was undertaken it was not possible to address any seasonality shifts in community composition. However, a few weeks after this survey was conducted Eurasian millfoil was reported by NDGFD staff while surveying a tributary of the Sheyenne River in North Dakota following a cursory survey approach (Steinwand, pers. com.). This finding provides some evidence that this species could be found at different times of the year, but does not negate the need for spring surveys as the season to most reliably survey for some of these species.

Terrestrial Plants of concern

Flowering rush was not observed nor collected during this survey of Devils Lake. However, sampling did not focus on flowering rush.

Additional Findings

While the focus of this effort centered on the agreed upon list of biota of known concern reported above, we also report on other species found during this survey. We report on other species found during this survey in the XXXXX-acre Devils Lake, but we have limited information about the presence or absence of the same species within the XXXX-acre Nelson River basin. Additional study is necessary to truly determine the significance of these findings. These additional studies should be the centerpiece of a long-term monitoring program for Devils Lake, Sheyenne and Red Rivers and Nelson River drainage.

The external fish parasite *Epistylis* sp., previously known to exist in Devils Lake (Peterson, 2002) was found during this survey. *Trichodina* sp., an external fish parasite, was found for the first time in Devils Lake. Literature suggests that *Trichodina and Epystylis* are widespread in freshwater bodies in North America. To date, *Epistylis* sp. and *Trichodina* sp., have not been reported elsewhere in the Nelson River basin despite some survey effort in Manitoba (Williamson pers com.). Given these results, it is important to examine fish as part of a much needed long-term monitoring program for Devils Lake, Sheyenne and Red Rivers and ultimately Lake Winnipeg. Without such an effort it is hard to determine the true significance, if any, of these findings.

Several snail species were collected as part of this effort. Native snails collected included: *Physella* sp. and *Stagnicola* spp. (possibly two different species). Three other snail species, *Pseudosuccinea columnella, Helisoma anceps, Planorbula* sp, were detected, but there is some uncertainty regarding their taxonomic identifications (Montz, 2005).

Each of the zooplankton species identified in the Devils Lake and Stump Lake samples are known to occur in the Nelson River drainage basin and other parts of Canada (Patalas *et al.*, 1994) (see Table 1 in the appendix for a complete list of species).

Phytoplankton data are listed in Table 3 (see Appendix 1). The phytoplankton species *Nodularia spumigena, Chaetoceros muelleri, Campylodiscus clypeis,* and *Surirella peisonis* have a preference for highly saline aquatic habitats (Williamson, 2005). Nitrogen-fixing cyanobacteria *Aphanizomenon and Anabaena* from Devils Lake appear to be similar to those found in downstream systems.

At the time of sampling the cyanobacterial component of the phytoplankton community in Devils and Stump Lakes was co-dominated by a larger number species in the *Microcystis* complex. While there is a great deal of taxonomic uncertainty regarding these species, in Devils Lake, species that have been recorded include *M. cf panniformis,* and *M. cf protocystis,* and what appears to be a species similar to *Pannus spumosa* in cell arrangement and colony format but with larger cells arranged in 1 to 3 layers. These specimens also appear similar to species described from Belgium as *Pannus leloupii* but recently transferred to the genus *Sphaerocavum* (Azevedo and Sant'Anna 2003). Confirmation of their identity would require additional work beyond the scope and purpose of this effort. An additional specimen was identified as *Sphaerocavum* sp.. Further work needs to be done to better characterize these species and their habitat requirements to better determine their ecological significance.

Eleven species of aquatic macrophytes were identified with all species native to the upper Midwestern region of the United States. The following aquatic macrophytes were located in Devils Lake during this survey:

Stuckenia pectinata (Sago pondweed)
Ruppia maritima (Widgeon grass)
Myriophyllum sibiricum (Northern watermilfoil)
Ceratophyllum demersum (coontail)

Potamogeton richardsonii (Clasping-leaf pondweed)
Potamogeton pusillus (Small pondweed)
Zannichellia palustris (horned pondweed)
Alisma gramineum (water plantain)
Lemna trisulca (Star duckweed)
Leman minor (Lesser duckweed)
Wolffia columbiana (watermeal).

Perleberg (2005) provides the following summary of macrophytes in different basins of the lake:

Main Basin (surveyed July 27, 2005)
Submerged vegetation was found in approximately two to nine feet of water and plants reached the water surface in depths of about five to seven feet. Sago pondweed was the most common species found and it formed beds at scattered locations. Widgeon grass was occasionally found interspersed within these beds. Northern watermilfoil was less commonly found but also formed beds, particularly in well-protected areas. Clasping pondweed and small pondweed were found in a few isolated locations. Coontail was found infrequently. Free-floating species (the duckweeds and watermeal) accumulated in a few locations along the leeward shorelines. A Sechi disc reading measured approximately five feet.

East Bay (surveyed July 28, 2005)
Submerged vegetation was found in three to seven feet of water and in protected areas it reached the water surface. Water depths greater than seven feet were not sampled. In protected areas, beds of northern milfoil, sago pondweed and widgeon grass were common. Small pondweed and duckweeds were found occasionally. Secchi disc reading was about four feet.

Pelican Bay (surveyed July 28, 005)
Submerged vegetation was abundant and reached the surface in the areas surveyed, which included depths from three to six feet. Clasping-leaf pondweed was more commonly found in the surveyed area of this bay than in the surveyed areas of the Main Bay or East Bay. Sago pondweed, widgeon grass, northern milfoil, small pondweed, coontail and horned pondweed were also found occurring in mixed beds. Submerged water plantain occurred near the access location along with several wetland emergent macrophytes that were not included in this survey. Secchi disc reading was about two feet.

Additional work is needed to understand the significance of these findings. Investigating their significance is beyond the scope of this effort. However, these findings should be fully considered in the design and implementation of a long-term monitoring program that all jurisdictions agree as necessary and desirable and of any mitigaition options under discussion by the interested jurisdictions.

Summary

None of the biota of concern were recorded during this limited biota survey. However, these results must be considered in light of the caveats included in the Introduction of this report. Additionally, the limitations of the effort as it relates to seasonal variations of Devils Lake biota must be recognized when evaluating the results obtained and in making management decisions.

We also report on additional findings made during this effort. It is clear that a long-term monitoring program is needed to further elucidate the significance of the findings reported here. The current survey is insufficient to completely fill in gaps in our knowledge of the biota of Devils Lake, Sheyenne River and Red Rivers and the Nelson River basin as contemplated by the Governments of the United States and Canada in their agreement in principle regarding the Devils Lake outlet. This effort provides useful information that should serve as the basis to develop a long-term monitoring plan and any mitigation that may be required.

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TABLES

Appendix 1. Tables

Table 1: Zooplankton in samples collected from Devils and Stump lakes (Source Manitoba Water Stewardship)

. Taxa	1A0 1-A	1B0 1-A	3C0 1-A	3C0 2-C	3C0 3-B	3D0 1-A	3D0 2-C	4A0 1-C	4B0 1-A	5A0 1-A	5B0 1-A	6A0 1-C	6B0 1-B	6B0 1-C	701 -A	702 -B	702 -A	SL0 1-A	SL0 2-B	SL0 3-C	SL0 4-C
Diacyclops bicuspidatus thomasi Forbes	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√				
Acanthocyclops vernalis Fischer	√		√	√				√	√	√	√			√	√	√	√	√			
Mesocyclops edax (Forbes)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√				
Eucyclops agilis (Koch)?								√													
Cyclops sps? Small			√																		
Cyclopoida nauplii	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√				
Diaptomus sicilis Forbes	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Diaptomus siciloides Lilljeborg	√	√	√	√																√	
Diaptomus nevadensis Light																		√	√	√	
Diaptomus clavipes Schacht	√			√	√					√				√		√					
Calanoida nauplii	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√		√
Daphnia pulex Leydig	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Diaphanosoma leuchtenbergianum	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√				
Ceriodaphnia quadrangula (O.F. Muller)															√		√				
Bosmina longirostris (O.F.Muller)			√																		
Gammarus lacustris Sars	√									√		√	√	√	√	√		√		√	√

Table 1A. Zooplankton Identified in Devils Lake (Source Minnesota Department of Natural Resources)

Taxa	Basins								
	1	2	3	4	5	6	7	Stump Lake	Pelican Lake
Bosmina longirostris									X
Diaphanosoma birgei	X	X	X	X	X	X	X		X
Daphnia schodleri	X	X	X	X	X	X	X	X	X
Ceriodaphnia sp.							X		
Leptodiaptomus sicilis	X	X	X	X	X	X	X	X	X
Aglaodiaptomus clavipes	X	X	X	X		X	X		X
Hesperodiaptomus nevadensis								X	
Mesocycops edax	X	X	X	X	X	X			X
Diacyclops thomasi		X	X	X	X	X	X		X
Orthocyclopos (?) modestus					X				

Table 2. Benthic invertebrates in Manitoba soft sediment samples collected from Devils and Stump lakes

Samples	**Chironomini**	**Orthocladiinae**	***Gammarus lacustris***	**Tubificidae (mainly *Quistandrilus* sp.)**	**Lumbriculidae (*Lumbriculus* sp. and *Stylodrilus* sp.)**	**Sphaeriidae (*Pisidium* sp.)**	**Glossiphonidae (*Erpodella* sp.)**	**Lymnaiedae (*Lymnaea* sp.)**	**Physidae**	**Hydrachnidia (*Hydracarina* sp.)**	**Nematomorpha (*Gordius* sp.)**
1A01-A	82	4	4		4						
1A01-B	140	14		2	17	2					
1A01-C	96	8	4	8	20						
1B01-A	44	12	8			8		32			
1B01-B	80	116	36	24	8						
1B01-C	8	16	13	1		1					
3C01-A											
3C01-B											
3C01-C			2								
3C02-A	3	2	5								
3C02-B	52	4	24								
3C02-C	3		5			6					
3C03-A	96	8	8								
3C03-B	44										
3C03-C	40			4		4					
3D01-A	192	40	16				8				
3D01-B	236	4	4								
3D01-C	272		8								
3D02-A	472	104				4	16				
3D02-B	238	4				4	4				
3D02-C	61	1	1			1					
4A01-A-MB	14	38	32	2	5	2					
4A01-B-MB	22	33	22	1	2	2					

4A01-C-MB	1	17	10		1						
Samples	**Chironomini**	**Orthocladiinae**	***Gammarus lacustris***	**Tubificidae (mainly *Quistandrilus* sp.)**	**Lumbriculidae (*Lumbriculus* sp. and *Stylodrilus* sp.)**	**Sphaeriidae (*Pisidium* sp.)**	**Glossiphonidae (*Erpodella* sp.)**	**Lymnaiedae (*Lymnaea* sp.)**	**Physidae**	**Hydrachnidia (*Hydracarina* sp.)**	**Nematomorpha (*Gordius* sp.)**
5A01-A-MB	69	37	19		18		1				5
5A01-B-MB	61	33	46		6						
5A01-C-MB	39	46	104								
5B01-A-MB	13	38	1		13			1			2
5B01-B-MB	36	60	92					64			4

Table 3: Phytoplankton in samples collected from Devils and Stump lakes (A = abundant, P = present, and R = rare).

Taxa	**1B01a**	**1A01a**	**3COCa**	**3C02a**	**3D01a**	**3D02a**	**4A01b**	**4A01c**	**4b01**	**5A01a**	**5B01a**	**6A01a**	**6B01a**	**701a**	**702a**	**SL01a**	**SL03a**	**SL02a**	**SLO4a**
Anabaena flos aquae	A	P	P	A	P	A		P		A	A	A	A	A	P				
Anbaena cf mendotae	P	P												A					
Anabaena spiroides	A		P	A	P	A			A	A	A	A	A	A					
Anabaena cf compacta														R					
Aphanocapsa conferta	P							P							P				
Aphanocapsa sp														P					
Aphanocapsa delicatissima					P	P			P	P									
Aphanocapsa endophytica					P					P	P		P	P					
Aphanizomenon flos aquae and morphs	A		A	A	A	A		P	A			P	A	A	A	P			
Aphanothece floccosa	P	P	P											P			A		
Aphanocapsa holsatica	P	P	A		P	P	P	P	P	P		P		P	P	P			
Aphanizomenon klebhanii (flos aquae complex*)*	A	P	A	P	A	A	P	P	A				A	P	P	P	A		
Aphanocapsa nebulosa				P											P				
Aphanocapsa nubilum																		P	
Aphanothece minutissima	P	P			P	A								P					
Aphanothece bachmanii					P		P						P	P					
Aphanothece clathrata						P								P					

Aphanothece smithi											P			P	P				
Aulacoseira granulata						P	P	P	P										
Botryococcus braunii	P	P	P								P			P	P				
Taxa	**1B01 a**	**1A01 a**	**3COC a**	**3C02 a**	**3D01 a**	**3D02 a**	**4A01 b**	**4A01 c**	**4b0 1**	**5A01 a**	**5B01 a**	**6A01 a**	**6B01 a**	**701 a**	**702 a**	**SL01 a**	**SL03 a**	**SL02 a**	**SLO4 a**
Botryococcus cf terribilis									P						P				
Campylodiscus clypeis																		P	
Ceratium furcoides	P		A	P	A	P	A		A	A	P	A	P	P	P	A			
Ceratium hiruninella	P		R				R			P		R				R			
Chaetoceros cf muellerii (additional analysis needed)														P	P	P		P	
Characium sp	A	P			P				P	P		P	P	P	P				
Chroomonas cf acuta	P													P					
Chroococcus limneticus						P	P			P	P					P			
Chroococcus minutus														P					
*Chroococcus cf prescottii (*may be *Eucapsis carpatica)*			P		P										P				
Closterium aciculare					P														
Coelastrum sp (cf microporum)				P											P				
Coelomoron sp					P														
Cryptomonas reflexa						P					P								
Cyanodictyon reticulatum	P		P		P					P					P				
Dimorphococcus lunatus												R							
Eremosphaeria cf eremosphaeria						P	P	P	P	P	P	P		P	P				
Eudorina elegans					P		P	P		P		P					P		
Gomphosphaerica cf virieuxii	P	P	P		P			P		P	P	P	P	P		P			
Lyngbya birgei	A		A	P	A	A	A	A	P		P	A	P	A	P	A			
Merismopedia warminginiana		P																	
Microcystis aeruginosa	A	P	A	A	A	A	A	A	A	A	P	A	P	A	P	A	A	A	A
Microcystis botrys		P													P				
Microcystis flos aquae	A	P	A	P	P	A	P	P	P	A	P	P	P	A	P	A	P	A	P
Microcystis ichthyoblabe		P			P			P					P	P	P	P	P	A	A
Microcystis novacekii	P	A	A		P	P	P	P		P	P	P	P	P		P	P	A	

Microcystis cf panniformis (additional analysis required)	P		P					P	P		P			P		P			
Microcystis cf protocystis (additional analysis required)						P			P	P		P	P	P	A			P	P
Microcystis smithii	P		P				P						P					P	
Microcystis sp (reddish colour - additional analysis required)		P		P	P						P	P		P			P		P
Taxa	**1B01 a**	**1A01 a**	**3COC a**	**3C02 a**	**3D01 a**	**3D02 a**	**4A01 b**	**4A01 c**	**4b0 1**	**5A01 a**	**5B01 a**	**6A01 a**	**6B01 a**	**701 a**	**702 a**	**SL01 a**	**SL03 a**	**SL02 a**	**SLO4 a**
Microcystis viridis	P		P											P					
Microcystis wesenbergii	P	P	A	A	P	A	A	P	A	P	P	A	P	P		P			
Nitzschia spp		P				P													
Nitzschia fonticola (epiphytic on microcystis)											P		P		P	P	P	P	
Nodularia spumigena															P				
Cf Pannus sp.. similar to spumosa and microcystiodes (additional analysis required)	P		P								P	P							
Pediastrum duplex	P		P		P	P	P	P	P	P	P	P	P	P	P	P			
Pediastrum boryanum											P	P	P			P			
Pseudanabaean limnetica																			
Pseudanabaena mucicola (endogleic in sheats of microcystis)		P					A				P			P		P	P	A	
Radiocystis sp (cf fernandoi)		P																	
Rhodomonas minuta						P													
Sphaerocystis schroeteri				P				P			P								
Sphaerocavum sp (some reddish colonies appear similar to S. leloupii but additional analyses are necessary)		P		P				P			P	P	P	P					
Staurastrum cf chaetoceros	P	P	P				A		A							P			
Staurastrum pingue/ cingulum							P	P			P	P				P			
Synedra cyclopum		P																	
Stephanodiscus niagarae	A	P	P	P		A	A	A	P	A	A	A	P	A	P	P			
Surirella peisonis	P		P									P		P					
Wornichinia karalia										P	P	P			A	A			
Wornichinia naeglianum	A	P		P	P		A		P			P	P			P			